Working Paper

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THE IMPACT OF PERFORMANCE FUNDING POLICY DESIGN ON COLLEGE ACCESS AND SELECTIVITY

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Introduction

American higher education remains highly stratified by race and class, even while college enrollment levels have expanded across subpopulations of students (Bailey & Dynarski, 2011; Chetty et al., 2017; Kane, 2004; National Center for Education Statistics, 2019). Students from racially minoritized and low-income backgrounds are also less likely to enroll in selective four-year colleges (Bastedo & Jaquette, 2011; Posselt et al., 2012), and these stratified enrollment patterns have grown over time (Astin & Oseguera, 2004; Baker et al., 2018; Ford et al., 2021). Within this stratified higher education system, minority serving institutions (MSIs) have emerged in response to the historical exclusion of racially minoritized students from higher education (Gasman et al., 2015). Despite the proliferation of MSIs throughout American higher education, these institution types have faced considerable challenges due to consistently low levels of public funding (Cunningham et al., 2014; Harris, 2021).

Historically, states have allocated funds for public higher education as a way to promote upward mobility, subsidizing colleges and universities in an effort to encourage enrollment by keeping tuition costs relatively low for students. State funding for public colleges and universities is associated with increased college enrollment, particularly among Black and Latinx students (Monarrez et al., 2021). However, with rising tuition levels, increasing student debt burdens, and stagnant graduation rates, one popular state policy response has been performance-based funding (PBF). PBF links a portion of state appropriations for public colleges and universities to student progression toward a degree or degree completion (Dougherty et al., 2016). In Fiscal

Year 2020, 32 states had PBF policies, and 41 states have had PBF policies in place for the community college sector, four-year sector, or both at some point over the last two decades (Rosinger, Ortagus, et al., 2021).

Research that examines the impact of PBF on bachelor's degree completion has generally found null or modest impacts (see Bell et al. (2018), Li (2021), and Ortagus et al. (2020) for recent comprehensive reviews of the literature). A smaller but growing body of research has examined unintended consequences of PBF policies, such as rising admissions standards and restricted access among historically underserved students at four-year institutions. For instance, prior studies on PBF in Indiana and nationwide have found that PBF policies have led to increased selectivity at four-year universities and decreased enrollment among some student subpopulations (e.g., Birdsall, 2018; Gándara & Rutherford, 2020; Umbricht et al., 2017).

This study extends prior research on the unintended consequences of PBF policies in several key ways. First, prior research has often used a binary treatment variable—whether a PBF policy exists or not—to examine the effects of PBF. This approach estimates a single overall effect for a heterogeneous set of policies whose features change over time and vary across states. For instance, PBF policies vary substantially in the share of funds tied to performance (ranging from less than 1% to 100%) and the specific subpopulations included in equity metrics (e.g., racially minoritized, low-income, and/or adult students). To advance PBF research, we draw on the most comprehensive and systematic data to date on the existence and aspects of PBF policies to examine how specific features of PBF policies shape college access and selectivity. To gather this detailed data, our research team reviewed thousands of policy documents, including state budgets and legislation and higher education agency reports, related to performance funding over a four-year period. This comprehensive data collection effort included direct correspondence with state higher education agency officials and allowed us to reconcile some of the discrepancies in prior studies regarding the years a particular state had PBF and even whether a state had PBF at all (Authors, 2021). Table 1 lists states with PBF for the four-year sector, the years the PBF policy was funded, and key PBF policy features.

See Table 1: PBF Policies for Four-Year Universities by State and Key Policy Features, 1997-2019.

Second, we also examine whether the unintended impacts of PBF policy features differ at MSIs versus non-MSIs. To date, we know relatively little about how PBF policies, and particularly how features of PBF policies, shape college enrollment patterns at MSIs, which play a critical role in expanding college enrollment opportunities for racially minoritized students (Gasman et al., 2015). Finally, we draw on recent advances in econometrics to account for biases introduced into generalized difference-in-differences designs when treatment timing varies across states. We leverage these new data and methodologies to answer the following research questions:

1. To what extent does the share of funds at stake in PBF systems impact college enrollment among racially minoritized, low-income, adult, and first-generation students?

2. To what extent does the share of funds at stake in PBF systems impact college selectivity (measured by 25th and 75th percentile SAT scores and acceptance rate)?
3. To what extent do equity metrics in PBF systems impact college enrollment among the subpopulations they target?
4. To what extent do the effects of PBF design features vary by institutional type (e.g., selectivity or MSI status)?

In this study, we do not find evidence of widespread decreases in college access among underserved subpopulations. However, we find some evidence of declining access among racially minoritized and low-income students at the most selective institutions and MSIs with the introduction of low-dosage PBF while moderately selective institutions and non-MSIs see gains in selectivity after adoption of high-dosage PBF. Across institution types, the presence of equity metrics was not enough to boost enrollment among the specific subpopulations they targeted. However, we found some evidence that PBF policies without race equity metrics may lead to declines in racially marginalized student enrollment at MSIs. We discuss the implications of these findings for how policymakers can design higher education funding policies to promote more equitable college enrollment outcomes. These findings are particularly important as states are expected to experience declining budgets in the coming years and will face difficult decisions regarding how to allocate funds following the COVID-19 pandemic.

PBF in Higher Education

Previous studies examining the impact of PBF adoption have typically indicated that PBF did not lead to increases in associate or bachelor's degree completion (see Ortagus et al. (2020) for a review), but a growing body of evidence has shown that community colleges, in particular, may seek shorter-term, quicker ways to improve their outcomes by increasing certificate production (Hillman et al., 2015; Li & Ortagus, 2019). Ward and Ost employed difference-in-differences and synthetic control approaches, finding that PBF adoption had no effect on bachelor's degree completions or total degree completions in Ohio and Tennessee. Additional studies focused on the community college sector reported that PBF had no effect on associate degree completion in Ohio (Hillman et al., 2018), Washington (Hillman et al., 2015), and Tennessee (Hillman et al., 2018; Li & Ortagus, 2019).

A series of qualitative studies have explored institutional responses to PBF adoption by interviewing practitioners and administrators working on college campuses. This research has suggested that institutions have responded to PBF by undertaking targeted efforts to improve academic support services (see Ortagus et al. (2020)). More specifically, Dougherty et al. (2016) indicated that institutions subject to PBF implemented efforts to improve tutoring and advising services, whereas Harbour and Nagy (2005) interviewed senior administrators in North Carolina and reported that institutions made targeted adjustments in programs and

staffing in order to improve performance on the metrics incentivized under their PBF system. However, administrators at numerous public colleges and universities have noted that PBF has the potential to limit their capacity to serve individuals who are more expensive to educate, such as academically underprepared students and individuals from low-income backgrounds (Jones et al., 2017).

Prior Literature on the Unintended Consequences of PBF

In recent years, the PBF literature has shifted from focusing on the intended outcomes of PBF, such as retention and degree completion, to considering the unintended outcomes of PBF adoption, such as restricting access to more selective institutions (see Ortagus et al. (2020)). Prior research on the impact of PBF in the state of Indiana has revealed that public four-year universities decreased admission rates and restricted access for racially minoritized and low-income applicants following the adoption of a PBF system (Birdsall, 2018; Umbricht et al., 2017). In a national study, Kelchen and Stedrak (2016) found that PBF implementation was negatively associated with Pell Grant revenue, suggesting that institutions may be responding to PBF adoption by enrolling fewer low-income students.

Additional national studies have explored the impact of the use of equity premiums in PBF policies, such as financial bonuses for enrolling racially minoritized, low-income, or adult students, as a way to counteract incentives for public four-year institutions to enroll a larger share of already-advantaged students deemed more likely to graduate (Gándara & Rutherford, 2018; Kelchen, 2018a). This limited body of evidence finds inconsistent results across student subpopulations. Gándara and Rutherford (2018) reported that PBF equity premiums had a positive impact on the proportion of Latinx and low-income students but a negative impact on the share of Black students. Conversely, Kelchen (2018a) found that equity-oriented PBF premiums had a positive impact on the proportion of Black students but no impact on enrollment among other racially minoritized subpopulations and Pell Grant recipients.

Another recent national study used institution-level data from 2001 to 2014 to explore whether public four-year institutions increased their selectivity or enrolled fewer underserved students under a PBF policy (Gándara & Rutherford, 2020). The authors reported that public four-year institutions become more selective when they were subject to PBF, indicating institutions decrease acceptance rates, increase 25th percentile SAT scores, and enroll fewer first-generation students in response to PBF adoption. In addition, the authors explored the role of PBF policy design by considering whether the PBF policy was linked to an institution's base funding (frequently referred to as PBF 2.0) or tied to bonus funds (PBF 1.0), finding that decreases in admission rates and the proportion of low-income or first-generation students are concentrated primarily within 2.0 policies.

The present study extends previous literature examining the impact of PBF adoption on college access and selectivity by leveraging a novel, comprehensive, and nuanced dataset designed to allow researchers to

consider the percentage of funds at stake (i.e., dosage) under PBF policies rather than dated conceptualizations of PBF 1.0 versus PBF 2.0 in which nearly every older PBF policy tied an extremely nominal percentage of funds to student outcomes (Rosinger, Ortagus, et al., 2021). Prior work considering the unintended consequences of PBF has yet to consider the critical role of MSIs operating under PBF policies by specifically examining the potential for differential impacts on college access and selectivity between MSIs and non-MSIs. The present study offers insights to researchers and policymakers by drawing on the best data available, considering specific features of PBF policies, and incorporating recent methodological advances that allow for stronger claims of causal inference in the presence of differential timing of treatment adoption and heterogeneous treatment effects (Goodman-Bacon, 2021; Sun & Abraham, 2020).

Conceptual Framework

We use a combination of principal-agent theory (Jensen & Meckling, 1976; Spence & Zeckhauser, 1971) and resource dependence theory (Pfeffer & Salancik, 1978) as the framework for our analyses. Public colleges and universities receive a substantial share of their funding from state governments, with institutions eligible for MSI status tending to be more reliant on state funding than predominantly white institutions (Kelchen et al., 2020). The need for MSIs and less selective institutions to receive state funding, even if funding levels have historically disadvantaged these institutions (Cunningham et al., 2014; Harris, 2021), has the potential to give state policymakers the power and ability to shape the behavior of these institutions more than wealthier institutions that may not be as reliant on state funds. Additionally, resource dependence theory suggests that PBF systems with larger shares of funding at stake may have more power over public institutions and are therefore more likely to successfully incentivize colleges to change their behaviors than PBF policies with less money tied to student outcomes.

PBF for higher education is part of a broader policy reform effort to hold public agencies more accountable for their outcomes (Moynihan, 2006). K12 education has seen accountability efforts in the form of No Child Left Behind, which linked federal funding for schools to students' performance on standardized tests, and other reforms (Heinrich, 2015; Ladd, 2011). However, performance-based reforms can lead to unintended consequences if educational systems are able to game the system to improve performance on specific metrics without making improvements to the quality of educational offerings (Kelchen, 2018b). Public agencies, for example, have previously responded to performance incentives by restricting service to some groups or focusing service delivery on individuals who are close to success thresholds (Koning & Heinrich, 2013; Lauen & Gaddis, 2016). These responses can exacerbate inequities by limiting services to individuals who are more likely to succeed rather than focusing on improving outcomes more broadly.

In the case of performance funding for higher education, linking a portion of state funding to student outcomes may incentivize institutions to raise admission standards and restrict enrollment among historically

underserved students (Hillman, 2016). By doing so, institutions may improve their performance on student outcome metrics by enrolling students who are more likely to graduate. However, this response may come at the expense of providing more equitable access to underserved student subpopulations. Increased admissions standards and restricted access may be particularly pronounced at colleges with selective admissions processes that are more able to craft admissions and financial aid decisions to enroll a desired group of students.

Based on our conceptual framework and prior research, we offer the following hypotheses for each of our research questions:

RQ1: We hypothesize there will be a negative relationship between the share of funds tied to performance and enrollment among racially minoritized, low-income, adult, and first-generation college students. That is, when larger shares of funds are tied to student outcome metrics, institutions may seek to become more selective and limit enrollment of underserved subpopulations.

RQ2: We hypothesize that PBF policies with larger shares of funds at stake will lead to increased institutional selectivity (as measured by 25th and 75th percentile SAT scores and acceptance rate).

RQ3: We expect that equity-focused metrics will mitigate the negative impact of PBF policies on enrollment for the specific subpopulations of students included in the policy (e.g., racially minoritized, low-income, and/or adult students).

RQ4: We expect that highly selective institutions will be more likely to become more selective and limit enrollment among underserved populations under PBF policies, particularly policies in which a larger share of funds are at stake or policies that do not provide equity premiums for enrolling and/or graduating underserved students. We do not have a specific hypothesis regarding MSIs, as they may have an incentive to restrict access but could also experience increases in enrollment if other institutions restrict access among racially minoritized students.

Data and Methods

Sample and Data

To examine how features of PBF policies shape college access and selectivity, we leveraged the most comprehensive longitudinal dataset to date on the existence and features of PBF policies. We merged this data with publicly available data on our outcomes of interest along with other institutional and state characteristics to create an analytic dataset spanning more than two decades from Fiscal Year 1997 to 2019. During this time period, 33 states operated PBF policies for public four-year universities.

Our sample consisted of public four-year degree-granting colleges in the United States, defined as doctoral, master's, and baccalaureate institutions using 2018 Carnegie classifications. We excluded special focus

institutions, military institutions, and tribal colleges from our sample. Our final sample included 581 public four-year universities.

Our research team collected data on the features of PBF policies from policy documents, including state budgets, legislation, and higher education agency documents that offered information regarding PBF policies over the last two decades. Over four years, our research team reviewed more than 2,000 policy documents, meeting regularly to review documents and ensure consistent interpretation and coding across research team members. We used the Internet Archive: Wayback Machine to locate historical versions of websites that contained relevant documents relating to PBF policies in earlier years. We reached out to state higher education agency officials for clarification if we could not locate relevant information or when information about particular aspects of PBF policies was unclear. See Authors (2019) for a description of our data collection protocol. The final dataset contains information regarding the years states allocated funds for performance, the share of state general funds budgeted based on performance, and whether states included equity metrics for specific subpopulations of students (racially minoritized, low-income, and/or adult students) in a given year for four-year universities.

To answer our first two research questions, our treatment variable of interest was a categorical variable indicating whether a college had no funds tied to performance metrics in a given year (no PBF), whether less than 10% of funds were at stake in a given year (low-dosage PBF), or whether more than 10% of funds were at stake in a given year (high-dosage PBF). The map below shows states with low- and high-dosage PBF policies in Fiscal Year 2019. Twenty-one states had performance funding for the four-year sector in 2019, 12 with high-dosage PBF and 9 with low-dosage PBF.

See Figure 1: Map of States with No PBF, Low Dosage PBF, and High Dosage PBF in 2019.

We also estimated models using a binary treatment variable (whether a college was subject to PBF in a given year) and a continuous treatment variable (the share of state general funds at stake in a given year). Findings reflect similar patterns to those presented and are shown in the online supplementary materials (Tables A1 and A2). We selected 10% as the threshold for "high-dosage" PBF because it was near the median value for colleges subject to PBF in 2019 (8.35%) and, from a policy perspective, is readily interpretable. In some cases, not all four-year universities in a state were subject to PBF. For instance, Pennsylvania's state-related four-year universities were not subject to PBF but the Pennsylvania State System of Higher Education institutions were. In these cases, we coded only institutions subject to PBF as having particular policy features.

To answer the third research question regarding the extent to which equity metrics impact college enrollment among the subpopulations they target, our treatment variables were categorical variables indicating the presence of specific equity-oriented metrics. These variables indicated whether a college was not subject to PBF (no PBF), whether a college had PBF (PBF), and whether a college had PBF that included the specific

equity-oriented metric (PBF with equity). We separately examined three specific equity-oriented metrics—racially minoritized student metrics, low-income student metrics, and adult student metrics—and estimated their impact on the specific subpopulations they target. For example, we examined the impact of the categorical variable for low-income student metrics on low-income student enrollment. The maps below show states with each equity-oriented metric in Fiscal Year 2019. Of the 21 states with PBF policies in 2019, 14 included a metric for colleges that enrolled and/or graduated racially minoritized students, 19 included a metric for low-income students, and 8 included a metric for adult students.

See Figure 2: Map of States with No PBF, PBF without Specific Equity Metrics, and PBF with Specific Equity Metrics.

Figure 3 shows the number of PBF policies for the four-year sector with the policy features we examine from Fiscal Year 1997 to 2019. Until 2009, all PBF policies for the four-year sector were low-dosage policies. The number of high-dosage policies has grown steadily since 2009, and since 2016, roughly a similar number of states have operated low- and high-dosage PBF policies. While a few states included equity metrics in early PBF policies, they are mainly a feature of newer PBF policies, with fairly steady growth in the number of states with equity metrics for each student group beginning around 2010.

See Figure 3: Number of PBF Policies for Four-Year Universities by Key Policy Features, 1999-2019.

We merged our PBF dataset with publicly available data on college access and selectivity outcomes from the Integrated Postsecondary Education Data System (IPEDS) and the College Scorecard. To examine the impact of PBF policy design on college access, our outcomes included enrollment among four historically underserved subpopulations of students: the number of first-time, first-year degree-seeking underrepresented minoritized students (defined as Black, Latinx, and Indigenous) (logged; source: IPEDS), the number of full-time, first-time degree-seeking federal grant aid recipients (logged; source: IPEDS)[1], number of adult students aged 25 or older (logged; source: IPEDS)[2], and the percent of first-generation college students (source: College Scorecard). Our institutional selectivity outcomes were 25th and 75th percentile SAT scores and admissions rate (source: IPEDS). We converted ACT scores to their SAT equivalent using concordance tables (College Board, 2009; College Board and ACT, 2018). We then converted older SAT scores to their newer SAT equivalents using the appropriate concordance table (College Board, 2016). We lagged all outcomes by one year to match enrollment and selectivity for a given year with features of PBF policies from the prior year (e.g.,

[1] The majority of federal grant recipients are Pell Grant recipients, which is targeted toward lower-income students.

[2] Data reporting is optional every other year; for institutions that did not report data in non-required years, we imputed the mean value of the surrounding years.

policies put into effect to fund institutions in Fiscal Year 2002, covering July 2001 to June 2002, were matched to enrollment in the 2002-2003 academic year).

Data for each outcome was not always available for the entire panel: analyses for federal grant aid recipients include 1999 to 2018, analyses for first-generation college students include 1997 to 2016, and analyses for selectivity outcomes include 2001 to 2019. Analyses for underrepresented minoritized student enrollment and adult student enrollment include the entire panel from 1997 to 2019.

To answer our final research question, we estimated models with each treatment variable (PBF dosage and equity-oriented metrics) by institutional selectivity and MSI-status to examine whether the impacts of PBF policy design vary across institution types. We used Barron's (2017) competitiveness classifications to code colleges as highly selective, moderately selective, and less selective or open access.[3] Highly selective colleges had a mean 75th percentile SAT score of around 1400 and an acceptance rate around 50%; moderately selective colleges had a mean 75th percentile SAT score of around 1200 and an acceptance rate around 70%; and less selective and open access colleges had a mean 75th percentile SAT score of around 1100 and an acceptance rate around 70%. To identify institutions classified as MSIs in each year of our analysis, we used data from Excelencia in Education (Excelencia in Education, 2021) for Hispanic-serving institutions and data from IPEDS for historically Black colleges and universities. To identify primarily Black colleges; Alaska Native and Native Hawaiian-serving institutions; Native American-serving, non-tribal institutions; and Asian American, Native American, Pacific Islander-serving institutions, we used U.S. Department of Education enrollment thresholds for MSI eligibility in a given year. We also estimated models by institutional mission based on 2018 Carnegie classifications (research, master's, and baccalaureate), and institutional resources (top and bottom quartiles for instructional expenditures per student); results are provided in the online supplementary materials (Tables A3 and A4).

We controlled for a number of college characteristics that are likely to shape enrollment and selectivity outcomes. These variables include full-time equivalent (FTE) undergraduate enrollment (logged), percent of students for whom racial identity information is unknown, percent part-time enrollment, in-state tuition and fees (logged), per-FTE instructional expenditures (logged), and per-FTE state appropriations (logged).[4] We also controlled for several demographic and economic features of states that could shape outcomes using data from the Bureau of Labor Statistics and the U.S. Census Bureau. These covariates include per-capita income

[3] Highly selective were defined as most, highly +, and highly competitive by Barron's (2017), moderately selective were defined as very +, very, competitive +, and competitive colleges, and less selective and open access were defined as less competitive and non-competitive colleges.

[4] We replaced implausibly large per-FTE instructional expenditure and state appropriation data with the following year's value in a small number of cases during the early years of our analysis.

(logged), unemployment rate, percent of adults with a bachelor's degree or higher, size of the state's college-aged population (logged), and share of college-aged population by race. We adjusted financial figures to constant 2018 dollars using the Consumer Price Index.

Table 2 shows descriptive statistics for variables included in our analyses with separate columns for each treatment status: no PBF, low-dosage PBF, high-dosage PBF, PBF without a race equity metric, PBF with a race equity metric, PBF without a low-income equity metric, PBF with a low-income equity metric, PBF without an adult equity metric, and PBF with an adult equity metric.

See Table 2: Descriptive Statistics for Variables of Interest by No PBF and Policy Features of PBF Policies.

Analytic Method

Since states enacted PBF policies at different times over the last two decades, we used a generalized difference-in-differences (GDiD) approach with two-way fixed effects to estimate the impact of variations in PBF policy design on college access and selectivity. GDiD is an extension of the canonical 2x2 difference-in-differences design with two groups (one treated and one untreated) and two time periods (one before treatment and one after treatment) that allows treatment timing to vary (Dague & Lahey, 2018) and that can be used when treatment is categorical or continuous. The GDiD model with two-way fixed effects can be expressed:

$$y_{it} = \beta_0 + \beta_1 PBF_{it} + \boldsymbol{\gamma X}_{it} + \boldsymbol{Z X}_{st} + \lambda_i + \delta_t + \varepsilon_{it}$$

where y_{it} is the outcome for institution i in time t; *PBF* indicates whether a college is subject to a particular type of PBF policy in a given year (e.g., categorical variable indicating no PBF, low-dosage PBF, or high-dosage PBF; categorical variables indicating no PBF, PBF without a specific equity metric, or PBF with a specific equity metric) and β_1 is the estimated impact of a particular PBF policy type on the outcome; $\boldsymbol{X}$ are time-varying college characteristics and $\boldsymbol{Z}$ are time-varying state characteristics; λ_i and δ_t are college and year fixed effects, respectively; and ε_{it} is the error term. We estimated cluster-robust standard errors at the state level (Bertrand et al., 2004; Cameron & Miller, 2015). For each outcome, we first estimated a model that included only the PBF policy variable of interest and college and year fixed effects. We then estimated a second model that included time-varying college- and state-level covariates. Given the number of outcomes we examined, we set our threshold for statistical significance at $p < .01$.

We then incorporated recent advances in the econometrics literature that account for potential bias in the GDiD approach (Goodman-Bacon, 2021; Sun & Abraham, 2020). When treatment timing varies across states, GDiD estimates come from a series of 2x2 comparisons between early adopters and never adopters, late adopters and never adopters, early adopters and late adopters prior to the late group actually adopting the policy, and late adopters and early adopters after the late group adopts the policy (Cunningham, 2020;

Goodman-Bacon, 2021). These comparisons complicate the traditional common trends assumption required for causal inference in DiD designs. First, in the generalized model, the common trends assumption needs to hold for each 2x2 comparison. Second, the final group of 2x2s that compare late adopters to states that have already adopted PBF can yield biased estimates in the presence of heterogeneous treatment effects. If the impact of treatment varies over time, the resulting estimates will capture all of these changes. An additional concern with GDiD estimates is that OLS attaches a different weight to each 2x2 estimate, which leads to observations in the middle of the panel being weighted more heavily in GDiD estimates than other observations. (See Cunningham (2020) and Goodman-Bacon (2019) for an overview of these issues).

To address concerns that differential treatment timing and heterogeneous treatment effects can result in biased GDiD estimates, we implement four of the most recent event study approaches from the econometrics literature that aim to produce consistent estimates: *did_imputation* (Borusyak, 2021; Borusyak et al., 2021), *did_multiplegt* (de Chaisemartin et al., 2021), *eventdd* (Clarke & Schyte, 2020), and *eventstudyinteract* (Sun & Abraham, 2020). We used the *event_plot* command to plot estimates and confidence intervals from these analyses. The four approaches currently support only binary treatments, so we use a binary variable indicating whether a college was subject to a funded PBF policy in a given year to estimate the models. Callaway et al. (2021) outline a new approach for continuous treatment variables but to date a package that allows researchers to implement this approach in Stata has not been released.

For each outcome variable, we estimated the four event studies using three samples: 1) the full analytic sample of four-year colleges, 2) a sample that excludes institutions that were subject to PBF at the start of the analytic period for each outcome to account for the lack of pre-policy observations for these institutions, and 3) a sample that excludes these institutions in addition to institutions where PBF was abandoned prior to 2019. The final restriction accounts for the assumption in event studies that once a policy is enacted, it remains in place. Across the four event study approaches and three samples used to estimate the event studies, we looked for consistency in trends in post-policy years to see how closely they aligned with GDiD estimates.

Limitations

Before presenting results from our analyses, we first note several limitations associated with existing data on students' racial, economic, and parents' educational backgrounds. IPEDS follows federal race data reporting standards, which includes nine race/ethnicity categories. These broad groupings obscure differences in students' experiences and outcomes within and across racial-ethnic categories (Teranishi et al., 2020), and make it difficult for researchers to identify who is "underrepresented" in higher education. Our study focuses on students identified as Black, Latinx, and Indigenous; however, we acknowledge that the way race and ethnicity data is reported may not reflect students' identities and that our conceptualization is an imperfect measure of who is "underrepresented" in higher education (see Gándara and Li (2020) for additional discussion of these limitations). In addition, the share of students included in the "race unknown" category

varies by institutional type with larger shares of "race unknown" enrollment at more selective colleges, which may affect the composition of other racial-ethnic groups (Ford et al., 2020). We controlled for the percent of students categorized as "race unknown," but this potential source of measurement error is an important limitation.

Our measure of enrollment among low-income students is also an imperfect measure of students' economic background. This measure includes the number of federal grant recipients enrolled at a college in a given year. While the majority of federal grant recipients are Pell Grant recipients, which is the largest federal grant aid program for students, this count also includes recipients of smaller federal education assistance programs and training funds. Receipt of the federal Pell Grant, which is targeted toward lower-income students, is also not a perfect indicator for low-income status. Many low-income students do not receive the Pell Grant, most commonly reporting that they did not apply for aid because they thought they were not eligible, did not want to take on debt, or did not know how to apply (Rosinger & Ford, 2019). However, this measure is the best measure in publicly available data regarding the enrollment of low-income students over time.

Finally, the way colleges and the federal government define first-generation college student (e.g., neither parent attended college, neither parent completed a college degree) alters who is included in the group and the results of empirical analyses of student outcomes (Toutkoushian et al., 2018, 2021). These data limitations may introduce measurement error into our estimates and also may serve to marginalize underserved students if their identities are not reflected in current data collection processes. However, despite these data limitations, the definitions that we use in this analysis generally align with how states constitute underserved subpopulations of students in their PBF policies.

Results

We begin by presenting results from our GDiD analyses for each research question. We then present event study results that incorporate four of the most recent estimation strategies in the emerging econometrics literature on difference-in-differences designs with time-varying policy adoption.

Generalized Difference-in-Differences Results

Table 3 presents GDiD results for our first two research questions that focus on examining the impact of PBF dosage on college access and selectivity outcomes. Low-dosage indicates a college was subject to a PBF policy linking less than 10% of funds to performance metrics in a given year, high-dosage indicates a college was subject to a PBF policy linking more than 10% of funds to performance metrics in a given year, and the referent category is no PBF. Results in the first column for each outcome come from a model that includes only treatment and college and year fixed effects, and results in the second column for each outcome come from a model that also adjusts for time-varying college- and state-level covariates. Panel A presents results for the

full analytic sample, Panels B through D present results for highly selective, moderately selective, and less selective and open access colleges, and Panels E and F present results for MSIs and non-MSIs.

See Table 3: Effects of PBF Dosage on College Enrollment and Selectivity Outcomes by Institution Type.

We do not find evidence of changes in enrollment among racially minoritized, federal grant recipient, adult, and first-generation college students with the adoption of either high- or low-dosage PBF policies at four-year universities. We find some evidence of an increase in 25th and 75th percentile SAT scores at institutions subject to high-dosage PBF after the enactment of these policies. Results indicate a 16-point increase in 25th percentile SAT scores and a 14-point increase in 75th percentile SAT scores after the adoption of high-dosage PBF, but these findings were not statistically significant at the 0.01 level once we adjusted for time-varying characteristics of colleges and states. While we found some evidence of increases in the SAT scores of enrolled students, we did not find evidence of statistically significant corresponding changes in acceptance rate with either high- or low-dosage PBF.

When we examined the impact of PBF dosage level by institution type, we found some evidence of decreases in racially minoritized and federal grant recipient enrollment after the implementation of low-dosage PBF policies at the most selective four-year colleges and MSIs. Estimated effects were negative but not statistically significant at the 0.01 level across all model specifications. For high-dosage policies, effects were negative but not statistically significant. We found some evidence of an increase in adult enrollment at MSIs following the implementation of low-dosage policies, but this was not statistically significant after adjusting for college- and state-level covariates. We found that increases in SAT scores of enrolled students were concentrated in moderately selective four-year colleges, with evidence of an 18 to 20-point increase in 25th percentile SAT scores and a 15 to 17-point increase in 75th percentile SAT scores at these institutions after the implementation of high-dosage PBF. We found similar increases in 25th and 75th percentile SAT scores at non-MSIs after the implementation of high-dosage PBF policies. We did not find similar changes in SAT scores with the adoption of low-dosage PBF by institutional selectivity or other institutional types (online supplementary materials, Table A3).

Results were generally similar for all institutions when we used a binary variable indicating the presence of a PBF policy (online supplementary materials, Table A1) or a continuous variable indicating the percent of state general funds tied to performance outcomes (online supplementary materials, Table A2). Results from these analyses indicated some evidence of an increase in 75th percentile SAT scores at public four-year colleges and non-MSIs and a decrease in federal grant recipient enrollment at the most selective colleges with the presence of *any* funded PBF policy. Results for our continuous treatment variable indicated that as the percent of funds at stake under PBF increased, 25th percentile SAT scores of enrolled students increased. This effect was concentrated in highly and moderately selective colleges and non-MSIs. We found some evidence of a decrease

in racially minoritized student enrollment as the share of funds at stake increased at moderately selective colleges.

We next examined whether the inclusion of equity metrics in PBF policies resulted in changes in enrollment among the specific groups of students targeted in the metrics. Table 4 presents results from these analyses, again with results for all sample institutions in Panel A followed by results by selectivity in Panels B-D and MSI status in Panels E and F. Once again, no PBF serves as the referent category, and we report estimates for whether or not a PBF policy included an equity metric for the specific subpopulations of students included in the enrollment outcome. Results for all four-year colleges indicate that enrollment among racially minoritized, federal grant recipient, and adult students did not change after the adoption of PBF, regardless of whether a PBF policy included an equity metric for the specific group of students or not.

See Table 4: Effects of PBF Equity Metrics on College Enrollment Among the Subpopulations They Target by Institution Type.

Across institution types, we similarly found little evidence of changes in enrollment among underserved student subpopulations, regardless of whether states included specific equity metrics for these subpopulations. At the most selective institutions, however, we found a decrease in the number of federal grant recipients, even in the presence of an equity metric focused on low-income students. This result was statistically significant at the 0.01 level after adjusting for time-varying college and state characteristics but was not statistically significant when we did not adjust for these factors. At MSIs, not including a race equity metric led to decreased enrollment among racially minoritized students, after adjusting for college- and state-level covariates. We did not find evidence of changes in enrollment among subpopulations targeted by equity metrics at other institution types (online supplementary materials, Table A4).

Event Study Results

We next report results from four event study approaches from the recent econometrics literature that are more robust estimators in the presence of variation in treatment timing and heterogeneous treatment effects (Goodman-Bacon, 2021; Sun & Abraham, 2020). To implement these approaches, we used the *did_imputation*, *did_multiplegt*, *eventdd*, and *eventstudyinteract* packages in Stata. Figure 4 shows results from the four event studies, which generally align with the GDiD results reported above. Across the four estimates, results were generally null in years following PBF implementation for racially minoritized, adult, and first-generation college students and acceptance rate. For federal grant recipients, *eventstudyinteract* results point to a decrease in enrollment two, three, four, and five years after adoption. Estimates from the other three event studies were negative but not statistically significant. This aligns with our GDiD findings that, at least at highly selective colleges, PBF policies with lower dosage levels (the majority of PBF policies) may have led to decreased enrollment among this group. Event study results for 25th and 75th percentile SAT

scores of enrolled students were positive and sometimes statistically significant, again providing some evidence of increased selectivity.

See Figure 4: Event Study Results.

In Figures A1 and A2 in the online supplementary materials, we report results from the same four event study estimates for the full sample of public four-year colleges with two sample restrictions: the first excludes colleges that were subject to PBF at the beginning of the analytic time period for each outcome; the second excludes both colleges that were subject to PBF at the beginning of the analytic time period for each outcome as well as colleges where PBF was abandoned prior to 2019. Results from these event studies generally align with GDiD results presented earlier but fewer estimates are statistically significant, perhaps due to reduced statistical power after restricting the sample to a smaller set of colleges. We present results from corresponding GDiD analyses with the same set of sample restrictions in the online supplementary materials (Table A5).

Discussion

This study leverages the most comprehensive data to date on PBF policies and recent econometric advances in difference-in-differences to examine how the share of funds at stake and the specific equity metrics states included in PBF policies shape college access and selectivity. This study advances our understanding of the unintended outcomes of PBF policies, particularly at MSIs that enroll large shares of students who have been underserved by our educational systems. In addition, we offer important insights into how specific features of PBF policy design shape institutional outcomes related to access and selectivity. Due to the widespread adoption of PBF policies across states, performance funding has become a common feature of higher education funding. This has shifted policy-relevant questions regarding PBF from *whether* states should adopt PBF to *how* states can design PBF policies in ways that promote more equitable student outcomes.

Our findings do not indicate widespread decreases in enrollment among underserved students with the implementation of either low- or high-dosage PBF policies. However, at the most selective institutions and MSIs, we find some evidence of decreases in enrollment among racially minoritized and low-income students following the adoption of low-dosage PBF policies. Equity metrics did not lead to enrollment gains among the subpopulations they target, particularly at the most selective colleges where we found decreases in low-income student enrollment even in the presence of equity metrics focused on low-income students. At MSIs, we find some evidence that *not* explicitly incentivizing race as a metric on which colleges are evaluated can lead to reduced enrollment among racially marginalized students. When it comes to selectivity, the adoption of high-dosage PBF policies led to increased SAT scores, largely concentrated at moderately selective colleges and non-MSIs.

Taken together, our findings offer evidence that PBF policies may exacerbate inequities in college access and selectivity. Our findings raise concerns that institution types that have played important roles in providing

upward mobility for racially minoritized students may restrict access after the adoption of PBF policies, even with lower-stakes low-dosage policies. MSIs have historically served a critical role in providing educational opportunity for students excluded from entering American higher education, and our findings indicate that PBF policies, even when a small share of funds are at stake, may incentivize these institutions to enroll fewer underserved students. Highly selective institutions, which are associated with higher graduation rates (Bowen et al., 2009; Long, 2010; Melguizo, 2010), a greater likelihood of graduate school enrollment (Eide et al., 1998), and increased earnings for graduates from underserved backgrounds (Dale & Krueger, 2002, 2014), already enroll few racially minoritized and low-income students and may further restrict enrollment with PBF adoption. Meanwhile, more-advantaged institution types—moderately selective colleges and non-MSIs—saw increased selectivity, enrolling students with higher SAT scores, on average, after the adoption of high-dosage PBF policies.

Implications for Policy

These findings align with prior PBF research indicating that PBF exacerbates disparities, for instance, in college enrollment (Umbricht et al., 2017; Birdsall, 2018; Gándara & Rutherford, 2020) and institutional funding (Hagood, 2019). However, by examining the ways in which specific aspects of PBF policies contribute to disparate outcomes, we can offer insight for policymakers seeking to understand how to design higher education funding policies that can reduce educational inequities.

Some states have adopted PBF policies, particularly in recent years, that tie a relatively large share of funds to student outcome metrics, while the majority of states continue to operate low-dosage PBF policies that tie less than 10% of funds to performance metrics (Rosinger, Ortagus, et al., 2021). This study shows that restricted access at some institution types occurred following the adoption of low-dosage PBF policies, whereas high-dosage PBF policies were associated with increased institutional selectivity at more-advantaged institution types. We do *not* interpret this to mean that high-dosage PBF policies are more equitable for several reasons: first, we do not find evidence of increased access among underserved student subpopulations; and second, the coefficients for high-dosage PBF policies were negative but did not reach the 0.01 threshold we set for statistical significance. One additional possible explanation for why low-dosage PBF policies led to restricted access at selective colleges and MSIs is that states with low-dosage policies are less likely to include equity metrics in their funding formula. Therefore, we conclude that PBF policies, even with low levels of funding at stake, have the potential to reduce access, particularly at highly selective colleges and MSIs if equity is not prioritized in the PBF formula.

We also offer several insights for policymakers regarding equity metrics. First, we find some evidence that *not* prioritizing race in equity metrics leads to decreased enrollment among racially minoritized students at MSIs, which represents the first evidence to date on the implications of policy design on college access at MSIs. This particular finding is especially critical given that state policymakers often avoid explicitly addressing race in

PBF policies (Gándara, 2020). States are more likely to include equity metrics based on income than race: just over half of PBF policies include race equity metrics while more than two-thirds include low-income equity metrics (Rosinger, Ortagus, et al., 2021). Our study highlights the importance of race-conscious efforts to reduce the potential unintended consequences of PBF. In doing so, our research aligns with prior work suggesting that higher education policies that do not affirmatively consider race, such as holistic admissions reviews, socioeconomic-based affirmative action, and percent plan admissions policies, are often limited when it comes to expanding college access for racially minoritized students (e.g., Long, 2007; Reardon et al., 2018; Rosinger, Ford, & Choi, 2021).

However, our study also indicates that PBF equity metrics are typically not enough to expand enrollment among specific subpopulations of students, even when those groups are prioritized in PBF policies. This may be because the amount of funding states link to equity metrics is too small to change institutional behavior. Thus, states may consider increasing the amount of funds linked to equity metrics in an effort to design more equitable PBF policies.

Implications for Future Research

This national study demonstrates that policy design is a consequential consideration in shaping the outcomes of PBF policies. In doing so, it highlights the importance of future research to consider the state contexts that shape both what these policies look like and the outcomes the policies achieve. Future research, for example, might consider the mechanisms through which states allocate non-performance funds to public colleges and universities. Despite variation across states, in most states, PBF policies tie a small share of funds to student outcome metrics (Rosinger, Ortagus, et al., 2021). The remainder is allocated based on previous years' appropriations, enrollment levels, or other mechanisms, sometimes adjusting for prior funding inequities or to boost funding levels for smaller schools (Lingo et al., 2021). These funding formulas, in addition to features of PBF policies, are likely to shape colleges' incentives to enroll particular students or restrict enrollment among others. We are not aware of prior research that examines how the varying funding mechanisms that exist alongside PBF shape enrollment outcomes. This type of research would offer additional insight into how states can develop more equitable, evidence-based funding formulas for higher education more broadly.

In addition to state policies relating to public college and university funding, the presence of additional state policies could also shape the impacts of PBF on college access and student success. At least 20 states have enacted statewide free college programs, many of which have emerged in the last decade and include programs in PBF-adopting states, such as the Tennessee Promise, Hawaii Promise, and Rhode Island Promise (Mishory & Granville, 2019). Many states also operate broad-based merit aid programs intended to keep high-achieving students in state for college and after graduation (Zhang & Ness, 2010). In an effort to improve college completion rates, states have also focused policy efforts on helping adults with some college but no degree return to college (Jenkins & Fink, 2020). These efforts that are designed to improve college access and student

success coincide with the implementation of PBF, and future research might consider the role these policies play in conjunction with PBF in promoting (or restricting) more equitable student outcomes.

Finally, future researchers will benefit from continual advances in GDiD designs that better account for how states implement educational policies in practice. Although recent advances in econometrics account for biases introduced when states or other units of analysis adopt policies at different times, methodological approaches to date still fail to fully account for the realities of policy implementation in two key ways. First, policies are often not binary in nature. As we demonstrate, PBF policies vary substantially within and across states over time in the share of funds tied to student outcome metrics. While the GDiD model can support continuous and categorical policy treatments and has been used in some prior analyses of educational policies (e.g., Carruthers & Fox, 2016; Domina et al., 2015; Gershenson & Tekin, 2018; Lucas and Mbiti, 2012a, 2012b), a Stata approach for accounting for non-binary treatments in the presence of differential treatment timing is still forthcoming (Callaway et al., 2021). In addition, current event study approaches do not support discontinuities in policy treatment. Yet states have implemented, halted, and re-implemented PBF policies over time (Rosinger, Ortagus, et al., 2021). As a result, even the most recent methodological advances do not fully account for the realities of state educational policy implementation. In this study, we use four event study approaches designed to overcome some of the limitations introduced when policies are enacted at different points in time, but we hope continued advances will account for continuous and categorical policy variables and the discontinuation and readoption of policies over time.

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Table 1: PBF policies for four-year universities by state and key policy features, 1997-2019

	Any PBF	Low-Dosage PBF	High-Dosage PBF	PBF Race Equity Metric	PBF Low-Income Equity Metric	PBF Adult Equity Metric
Arizona	2013-14, 2016-17	2013-14, 2016-17				
Arkansas	2008, 2019	2008, 2019		2019	2019	2019
Colorado	2001-03, 2016-19	2001-03	2016-19	2001-03, 2016-19	2016-19	
Florida	1997-99, 2008, 2013-19	1997-99, 2008, 2013-14	2015-19	1998, 2015-19	2015-19	2017-19
Hawaii	2017-19	2017-19		2017-19	2017-19	
Illinois	2013-14	2013-14		2013-14	2013-14	2013-14
Indiana	2007-19	2007-19			2009-19	
Kansas	2006-09, 2013, 2015, 2019	2006-09, 2013, 2015, 2019		2006-09, 2013, 2015, 2019	2013, 2015, 2019	2006-09, 2013, 2015, 2019
Kentucky	1997-98, 2018-19 (except Kentucky State University in 2018)	1997-98	2018-19	2018-19	2018-19	1997-98
Louisiana	2017-19		2017-19		2017-19	2017-19
Massachusetts	2016-17 (non-UMass)	2016-17 (non-UMass)		2016-17 (non-UMass)	2016-17 (non-UMass)	
Maine	2014-18 (most)	2014-15 (most)	2016-18 (most)			2014-18 (most)
Michigan	2006-07, 2013-19	2006-07, 2013-19			2015-19	
Minnesota	2008-09, 2012-17 (all), 2018-19 (MnSCU)	2008-09, 2012-17 (all), 2018-19 (MnSCU)		2016-17 (all)	2008-09, 2014-15 (all)	
Missouri	1997-2001, 2014-16	1997-2001, 2014-16		1997-2001	1997-2001	
Mississippi	2014		2014		2014	2014
Montana	2015-19	2015-19		2015-19	2015-19	2015-19
North Dakota	2014-19		2014-19			
New Jersey	2000-02	2000-02				
New Mexico	2013-19	2013-14, 2017-19	2015-16		2013-19	
Nevada	2015-19	2015	2016-19	2015-19	2015-19	2015-19

Ohio	1998-2019	1999-2009	2010-19	2012-19	1998-2019	2012-19
Oklahoma	2002-14	2002-14			2012-14	
Oregon	2008-10, 2012-19	2008-10, 2012-15	2016-19	2012-19	2016-19	
Pennsylvania	2001-19 (PASSHE)	2001-19 (PASSHE)		2001-19 (PASSHE)	2011-19	
Rhode Island	2019	2019		2019	2019	
South Carolina	1998-2002	1998-2002				
South Dakota	2000-03, 2005-10, 2013	2000-03, 2005-10, 2013				
Tennessee	1997-19	1997-2011	2012-19	2011-19	2011-19	2011-19
Texas	2009-11	2009-11			2009-11	
Utah	2014-19	2014-19			2015-19	
Washington	1998-99	1998-99				
Wisconsin	2019	2019		2019	2019	

Source: Authors' review of state policy documents.

Notes. Low-dosage PBF policies are defined as those that link between 0.001 and 9.999% of state general funds to performance metrics. High-dosage PBF policies are defined as those that link more than 10% of state general funds to performance metrics.

Table 2: Descriptive statistics for variables of interest by no PBF and policy features of PBF policies

		PBF Dosage		PBF Race Equity		PBF Low-Income Equity		PBF Adult Equity	
	No PBF	Low-dosage PBF	High-dosage PBF	PBF without metric	PBF with metric	PBF without metric	PBF with metric	PBF without metric	PBF with metric
Outcomes									
Racially minoritized student enrollment	401.23	348.22	512.06	394.13	365.06	306.11	438.48	366.46	451.44
	(478.11)	(399.32)	(550.70)	(442.74)	(436.87)	(388.95)	(466.93)	(424.35)	(498.04)
Federal grant recipient enrollment	529.64	555.13	744.68	595.52	588.40	472.85	688.18	565.57	721.48
	(443.36)	(415.40)	(515.43)	(458.06)	(418.17)	(371.76)	(472.01)	(430.23)	(481.66)
Adult student enrollment	1855.74	1885.38	2120.21	2077.90	1711.38	1867.44	1983.90	1927.88	1964.14
	(2048.10)	(1839.30)	(2072.67)	(1905.05)	(1852.47)	(1896.86)	(1888.96)	(1938.04)	(1688.82)
First-generation student enrollment (%)	38.08	39.48	36.44	39.44	38.41	39.16	39.03	39.39	37.15
	(9.06)	(8.39)	(7.72)	(8.90)	(7.12)	(8.46)	(8.27)	(8.47)	(7.35)
25th percentile SAT scores	1013.80	1002.69	1042.11	1010.36	1013.83	1005.87	1016.13	1005.27	1039.14
	(104.96)	(88.79)	(102.30)	(93.47)	(93.69)	(84.78)	(99.23)	(90.99)	(99.14)
75th percentile SAT scores	1209.26	1199.24	1231.29	1208.12	1204.71	1201.08	1210.70	1201.77	1227.09
	(105.33)	(87.91)	(99.51)	(93.17)	(89.70)	(81.21)	(98.43)	(89.57)	(97.64)
Acceptance rate	68.39	73.61	72.81	73.22	73.70	73.85	73.11	73.14	74.53
	(17.52)	(15.18)	(18.33)	(15.90)	(16.05)	(15.42)	(16.34)	(15.47)	(17.75)
PBF policy variables									
PBF binary policy	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
PBF dosage	0.00	1.00	2.00	1.10	1.39	1.05	1.33	1.10	1.68
	(0.00)	(0.00)	(0.00)	(0.30)	(0.49)	(0.22)	(0.47)	(0.30)	(0.47)
PBF race equity	0.00	1.30	1.72	1.00	2.00	1.26	1.49	1.29	1.79
	(0.00)	(0.46)	(0.45)	(0.00)	(0.00)	(0.44)	(0.50)	(0.46)	(0.40)
PBF low-income equity	0.00	1.50	1.90	1.49	1.73	1.00	2.00	1.52	1.84
	(0.00)	(0.50)	(0.31)	(0.50)	(0.45)	(0.00)	(0.00)	(0.50)	(0.37)

PBF adult equity	0.00	1.08	1.62	1.06	1.39	1.07	1.28	1.00	2.00
	(0.00)	(0.27)	(0.49)	(0.25)	(0.49)	(0.26)	(0.45)	(0.00)	(0.00)
College-level covariates									
FTE undergraduate enrollment	8852.93	9404.29	11275.52	10021.53	9450.37	8482.47	10755.84	9578.35	10731.18
	(7833.27)	(8362.99)	(10067.93)	(9098.13)	(8254.17)	(7645.51)	(9409.69)	(8636.10)	(9321.21)
Percent race unknown enrollment	3.40	2.78	2.19	2.57	2.80	3.03	2.39	2.60	2.92
	(5.99)	(4.97)	(3.13)	(3.84)	(5.69)	(5.45)	(3.95)	(4.08)	(6.52)
Percent part-time enrollment	21.83	22.43	24.09	24.92	19.42	22.65	22.86	22.75	22.89
	(15.85)	(14.81)	(13.76)	(14.48)	(14.19)	(14.74)	(14.52)	(14.81)	(13.74)
In-state tuition	5924.78	6408.69	8109.70	6302.46	7491.95	5559.50	7644.47	6570.20	7605.65
	(3181.18)	(2818.45)	(2193.92)	(2757.75)	(2674.22)	(2433.20)	(2696.84)	(2831.84)	(2413.13)
Per-FTE instructional spending	8573.26	8290.62	9331.37	8205.66	8982.20	7817.08	9011.84	8388.79	9030.77
	(4548.40)	(3787.29)	(4204.98)	(3950.22)	(3783.86)	(3053.49)	(4344.96)	(3930.33)	(3746.75)
Per-FTE state appropriations	8391.70	7172.06	6476.99	7320.22	6571.11	7326.13	6806.24	7048.98	6917.73
	(5350.58)	(3826.27)	(5243.15)	(4018.81)	(4373.54)	(3149.06)	(4771.85)	(4201.58)	(4081.57)
State-level covariates									
Per-capita income	37666.62	37248.37	45096.63	36469.48	42733.66	35435.90	41416.03	38001.61	42761.42
	(10569.15)	(8208.32)	(5558.35)	(7503.23)	(8204.52)	(7931.43)	(7748.85)	(8646.65)	(5597.35)
Unemployment rate	5.65	5.49	5.48	5.59	5.34	5.19	5.70	5.45	5.66
	(1.90)	(1.72)	(2.04)	(1.83)	(1.73)	(1.64)	(1.87)	(1.80)	(1.75)
Percent of adults with bachelor's degree	19.57	18.77	21.12	17.94	21.35	18.40	19.90	19.06	20.15
	(4.58)	(3.63)	(4.16)	(3.17)	(3.95)	(3.57)	(3.96)	(4.01)	(3.06)
College-aged population	759741.57	589256.68	658015.59	558639.67	674433.81	445104.45	717898.70	608171.73	585785.06
	(797899.20)	(392573.75)	(498718.00)	(410086.49)	(421254.10)	(278566.18)	(462378.44)	(420456.23)	(408701.70)
Share of Black college-aged adults	14.79	11.65	14.04	12.52	11.59	11.28	12.78	11.39	15.36
	(11.70)	(6.48)	(10.56)	(8.32)	(6.27)	(7.64)	(7.50)	(6.57)	(10.31)
Share of Latinx college-aged adults	10.55	7.98	10.08	8.26	8.68	6.03	10.15	8.81	6.81
	(11.03)	(10.01)	(10.86)	(11.74)	(7.28)	(6.97)	(11.75)	(10.75)	(7.46)
Share of American Indian or Alaska Native college-aged adults	1.03	1.43	1.28	1.88	0.65	1.92	1.03	1.57	0.69
	(2.38)	(2.97)	(2.46)	(3.48)	(1.15)	(3.13)	(2.61)	(3.12)	(1.18)

Sources: Integrated Postsecondary Education Data System (IPEDS) (all outcomes except first-generation student enrollment), College Scorecard (first-generation student enrollment), authors' data collection (PBF policy variables), IPEDS (college-level covariates), Bureau of Labor Statistics and Census (state-level covariates).

Notes: PBF binary policy is equal to 1 in funded PBF years and 0 otherwise. PBF dosage is a categorical variable equal to 0 in non-PBF years, 1 in years when between 0.001 and 9.999% of funds were tied to performance metrics, and 2 in years when >10% of funds were tied to performance metrics. PBF race, income, and adult equity are equal to 0 in non-PBF years, 1 in years when a funded PBF system existed without a metric for that specific subpopulation, and 2 in years when a funded PBF system existed with a metric for that specific subpopulation. Financial figures adjusted to 2018 dollars using the Consumer Price Index. Data comes from Fiscal Years 1997 to 2019, except federal grant recipient student enrollment (1999-2018), first-generation student enrollment (1997-2016), 25th and 75th percentile SAT scores, and acceptance rate (2001-2019).

Table 3: Effects of PBF dosage on college enrollment and selectivity outcomes by institution type

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)		First-generation student enrollment (%)		25th percentile SAT scores		75th percentile SAT scores		Acceptance rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Panel A: All four-year colleges													
Low-dosage PBF	0.032	0.041	-0.030	-0.025	0.019	0.016	0.038	-0.122	3.449	1.857	4.047	3.454	-1.628	-1.760
	(0.036)	(0.031)	(0.029)	(0.017)	(0.023)	(0.016)	(0.479)	(0.355)	(2.416)	(2.441)	(2.050)	(2.116)	(1.095)	(1.103)
High-dosage PBF	-0.068	0.013	-0.054	-0.013	0.047	0.022	-0.109	0.388	15.857*	14.471	14.247*	12.773	-1.231	-1.151
	(0.067)	(0.048)	(0.076)	(0.038)	(0.048)	(0.035)	(0.953)	(0.538)	(5.731)	(5.862)	(5.104)	(5.092)	(1.735)	(1.792)
Number of observations	12,315	11,744	10,684	10,166	12,523	11,744	10,874	10,163	9,112	8,631	9,112	8,631	9,422	8,926
	Panel B: Highly selective colleges													
Low-dosage PBF	-0.084	-0.090*	-0.081	-0.100**	-0.098	-0.045	-0.815	-0.178	0.838	0.791	3.320	4.622	-2.552	-2.074
	(0.048)	(0.029)	(0.029)	(0.030)	(0.037)	(0.026)	(0.779)	(0.546)	(9.075)	(6.214)	(6.628)	(4.588)	(2.024)	(1.752)
High-dosage PBF	-0.117	-0.059	-0.067	-0.121	-0.005	0.015	-3.173	-0.155	7.534	29.989	-4.798	12.189	-0.065	-2.761
	(0.108)	(0.077)	(0.047)	(0.080)	(0.089)	(0.067)	(1.239)	(0.914)	(26.397)	(10.509)	(21.256)	(8.934)	(4.458)	(2.699)
Number of observations	869	841	756	731	869	841	751	730	721	699	721	699	721	699
	Panel C: Moderately selective colleges													
Low-dosage PBF	0.039	0.039	-0.015	-0.030	0.020	0.011	0.193	0.010	4.260	3.546	3.881	4.041	-2.118	-2.182
	(0.037)	(0.030)	(0.037)	(0.021)	(0.024)	(0.016)	(0.529)	(0.391)	(2.611)	(2.309)	(2.308)	(2.246)	(1.250)	(1.102)
High-dosage PBF	-0.123	-0.068	-0.069	-0.036	0.046	0.003	0.214	0.655	20.920***	18.171**	17.254*	14.798*	-1.944	-1.756
	(0.070)	(0.047)	(0.074)	(0.045)	(0.055)	(0.042)	(0.969)	(0.587)	(5.637)	(5.240)	(5.886)	(5.442)	(1.976)	(1.834)
Number of observations	8,094	7,933	7,027	6,884	8,096	7,929	7,038	6,886	6,277	6,162	6,277	6,162	6,395	6,279
	Panel D: Less selective and open access colleges													
Low-dosage PBF	0.006	0.030	-0.085	-0.034	0.036	0.028	-0.498	-0.551	1.683	-3.983	3.198	0.186	1.577	1.487 (2.022)
	(0.044)	(0.049)	(0.036)	(0.029)	(0.033)	(0.021)	(0.573)	(0.319)	(6.930)	(5.814)	(4.955)	(4.912)	(1.868)	
High-dosage PBF	0.090	0.104	-0.162	-0.019	0.119	0.021	0.194	-0.637	-5.697	-13.164	4.618	-4.687	2.092	2.705
	(0.144)	(0.073)	(0.083)	(0.070)	(0.106)	(0.058)	(1.252)	(0.979)	(8.276)	(11.351)	(8.482)	(11.056)	(2.824)	(3.157)

Number of observations	2,276	2,242	1,976	1,944	2,276	2,242	1,974	1,943	1,473	1,457	1,473	1,457	1,548	1,531
	Panel E: Minority-serving institutions													
Low-dosage PBF	-0.050	-0.100**	-0.057	-0.075*	0.066*	0.032	0.547	0.066	4.542	2.316	-1.469	-0.519	-2.576	-3.068
	(0.030)	(0.029)	(0.033)	(0.027)	(0.024)	(0.015)	(0.432)	(0.453)	(4.439)	(3.494)	(2.233)	(3.932)	(1.929)	(2.900)
High-dosage PBF	-0.094	-0.004	-0.084	-0.013	-0.011	0.030	-0.574	-0.030	-9.234	-2.918	0.311	6.307	-0.722	-2.782
	(0.163)	(0.069)	(0.116)	(0.080)	(0.066)	(0.039)	(1.996)	(1.768)	(7.948)	(10.021)	(7.687)	(12.208)	(5.027)	(4.829)
Number of observations	2,495	2,437	2,175	2,128	2,515	2,435	2,173	2,093	1,775	1,736	1,775	1,736	1,839	1,794
	Panel F: Non-minority-serving institutions													
Low-dosage PBF	0.029	0.040	-0.027	-0.017	0.014	0.017	0.052	-0.039	4.517	3.252	5.143	4.850	-1.564	-1.597
	(0.038)	(0.033)	(0.026)	(0.017)	(0.022)	(0.017)	(0.436)	(0.325)	(2.684)	(2.450)	(2.242)	(2.128)	(1.235)	(1.152)
High-dosage PBF	-0.135	-0.057	-0.079	-0.030	0.048	0.015	0.279	0.598	23.762***	21.009**	18.042**	15.276*	-1.252	-0.954
	(0.078)	(0.049)	(0.075)	(0.040)	(0.049)	(0.041)	(0.833)	(0.592)	(6.513)	(6.191)	(6.136)	(5.504)	(1.794)	(1.854)
Number of observations	8,878	8,698	7,703	7,542	9,031	8,700	7,864	7,549	6,740	6,613	6,740	6,613	6,942	6,812
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Covariates		X		X		X		X		X		X		X

Notes: Highly selective defined as most, highly +, and highly competitive colleges; moderately selective defined as very +, very, competitive +, and competitive colleges; less selective and open access defined as less competitive and non-competitive (Barron's, 2017). Referent category is no PBF. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

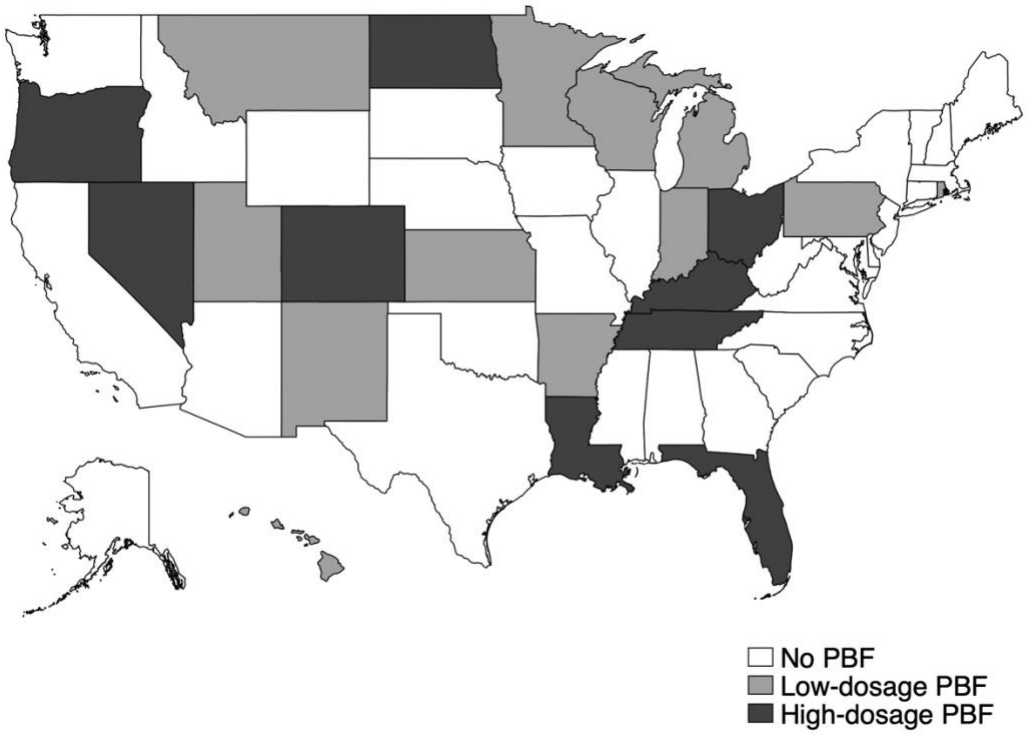
Table 4: Effects of PBF equity metrics on college enrollment among the subpopulations they target by institution type

	Racially minoritized student enrollment (ln)		**Federal grant recipient enrollment (ln)**		**Adult student enrollment (ln)**	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: All four-year colleges					
PBF without specific student metric	0.023	0.041	-0.026	-0.024	0.028	0.020
	(0.047)	(0.035)	(0.048)	(0.021)	(0.025)	(0.017)
PBF with specific student metric	0.005	0.029	-0.041	-0.024	-0.000	0.001
	(0.050)	(0.041)	(0.036)	(0.024)	(0.041)	(0.028)
Number of observations	12,315	11,744	10,684	10,166	12,523	11,744
	Panel B: Highly selective colleges					
PBF without specific student metric	-0.069	-0.068	-0.027	-0.017	-0.090	-0.042
	(0.059)	(0.032)	(0.048)	(0.059)	(0.037)	(0.026)
PBF with specific student metric	-0.126	-0.136	-0.128	-0.178*	-0.057	-0.023
	(0.058)	(0.067)	(0.046)	(0.056)	(0.042)	(0.063)
Number of observations	869	841	756	731	869	841
	Panel C: Moderately selective colleges					
PBF without specific student metric	0.034	0.042	-0.033	-0.047	0.028	0.014
	(0.047)	(0.034)	(0.055)	(0.026)	(0.027)	(0.017)
PBF with specific student metric	-0.029	-0.018	-0.009	-0.011	0.000	-0.008
	(0.060)	(0.044)	(0.034)	(0.026)	(0.046)	(0.034)
Number of observations	8,094	7,933	7,027	6,884	8,096	7,929
	Panel D: Less selective and open access colleges					
PBF without specific student metric	-0.028	0.015	-0.022	0.029	0.053	0.026
	(0.058)	(0.049)	(0.048)	(0.027)	(0.041)	(0.022)
PBF with specific student metric	0.097	0.087	-0.160	-0.080	0.036	0.032
	(0.048)	(0.069)	(0.073)	(0.049)	(0.067)	(0.057)
Number of observations	2,276	2,242	1,976	1,944	2,276	2,242

	Panel E: Minority-serving institutions					
PBF without specific student metric	-0.051	-0.093*	0.018	-0.034	0.062	0.029
	(0.041)	(0.034)	(0.067)	(0.066)	(0.024)	(0.014)
PBF with specific student metric	-0.091	-0.036	-0.118	-0.078	-0.023	0.045
	(0.115)	(0.059)	(0.082)	(0.054)	(0.067)	(0.041)
Number of observations	2,495	2,437	2,175	2,128	2,515	2,435
	Panel F: Non-minority-serving institutions					
PBF without specific student metric	0.022	0.044	-0.052	-0.029	0.022	0.021
	(0.050)	(0.039)	(0.043)	(0.023)	(0.024)	(0.018)
PBF with specific student metric	-0.024	-0.007	-0.012	-0.007	0.003	-0.003
	(0.059)	(0.044)	(0.032)	(0.021)	(0.042)	(0.035)
Number of observations	8,878	8,698	7,703	7,542	9,031	8,700
Two-way fixed effects	X	X	X	X	X	X
Covariates		X		X		X

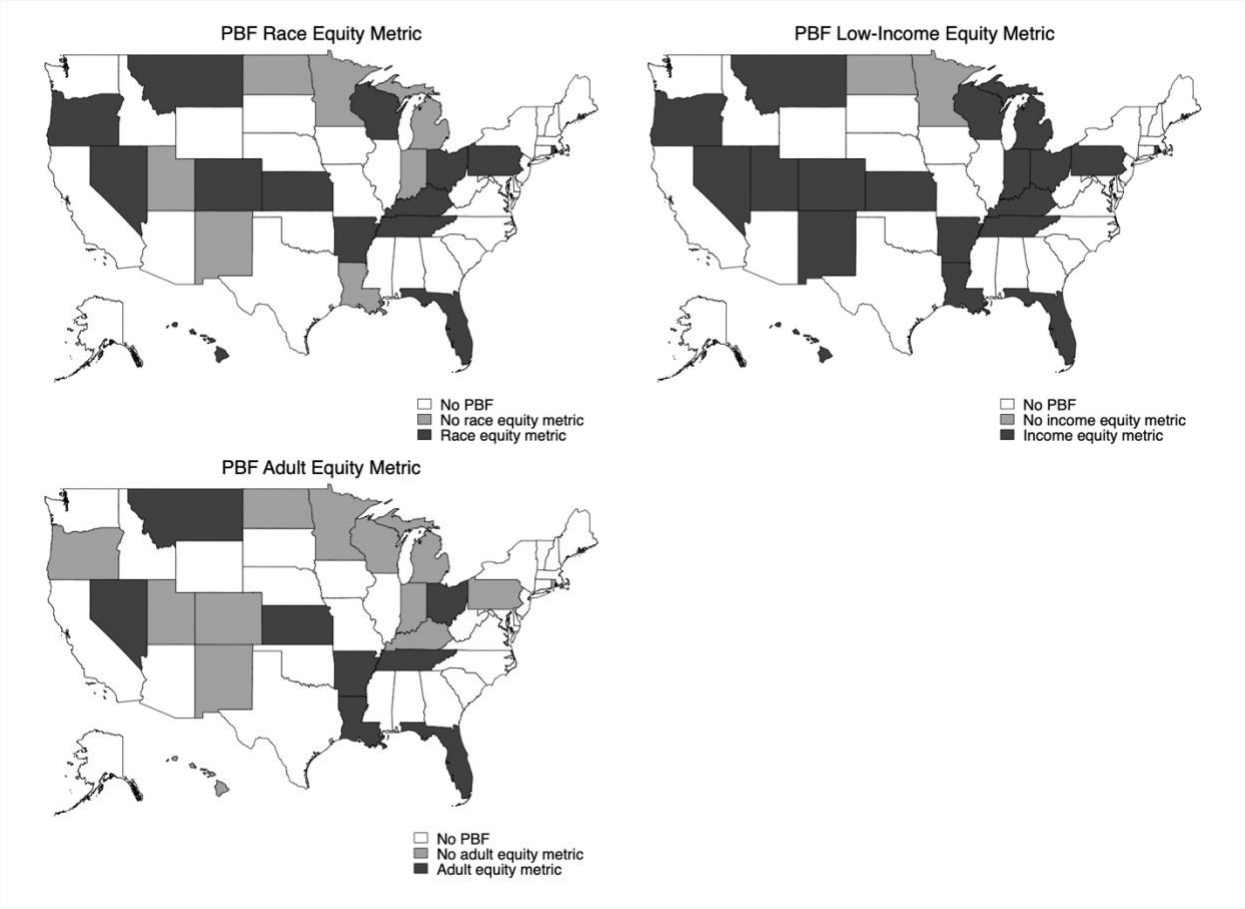
Notes: Highly selective defined as most, highly +, and highly competitive colleges; moderately selective defined as very +, very, competitive +, and competitive colleges; less selective and open access defined as less competitive and non-competitive (Barron's, 2017). Referent category is no PBF. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Figure 1. Map of states with no PBF, low-dosage PBF, and high-dosage PBF in 2019



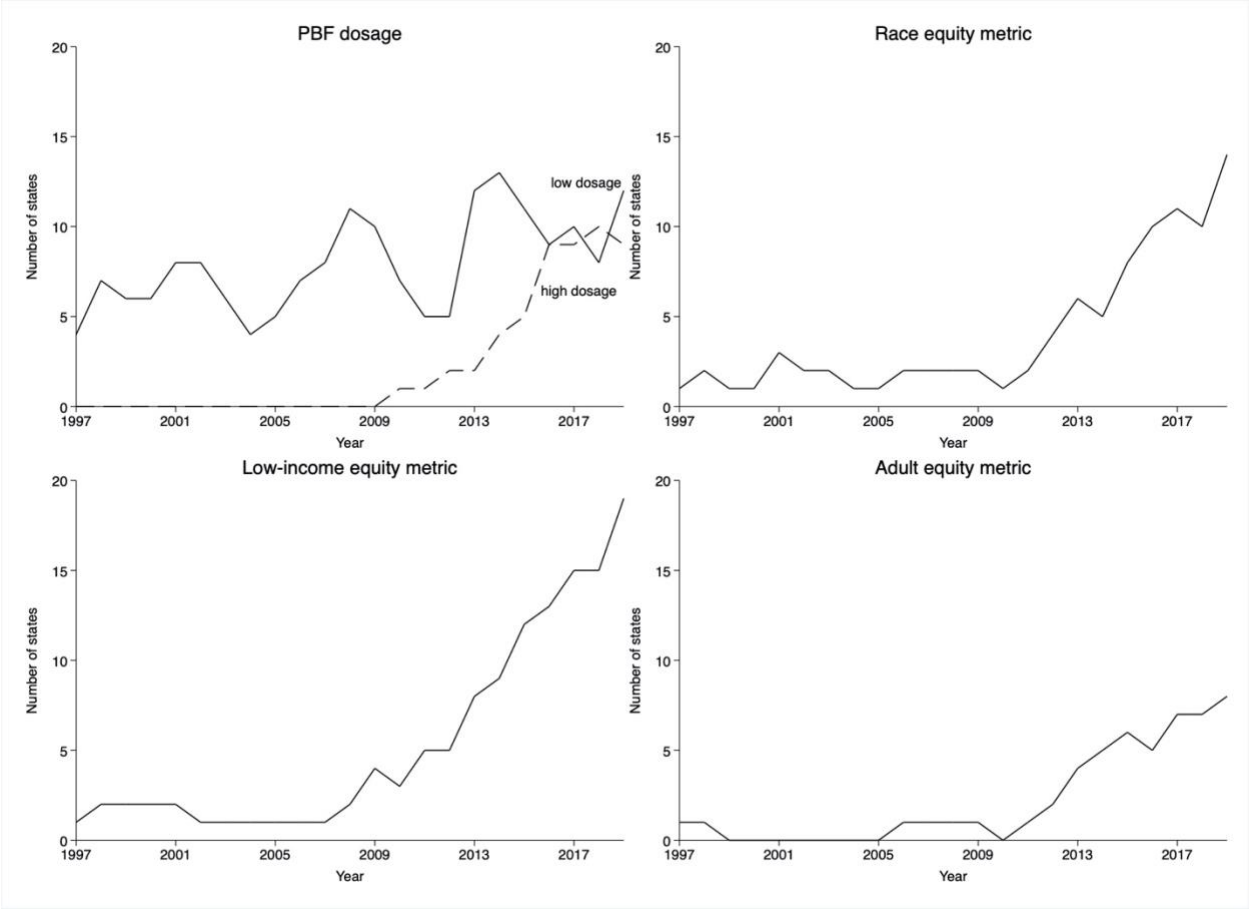
Source: Authors' review of state policy documents.

Figure 2. Map of states with no PBF, PBF without specific equity metrics, and PBF with specific equity metrics in 2019



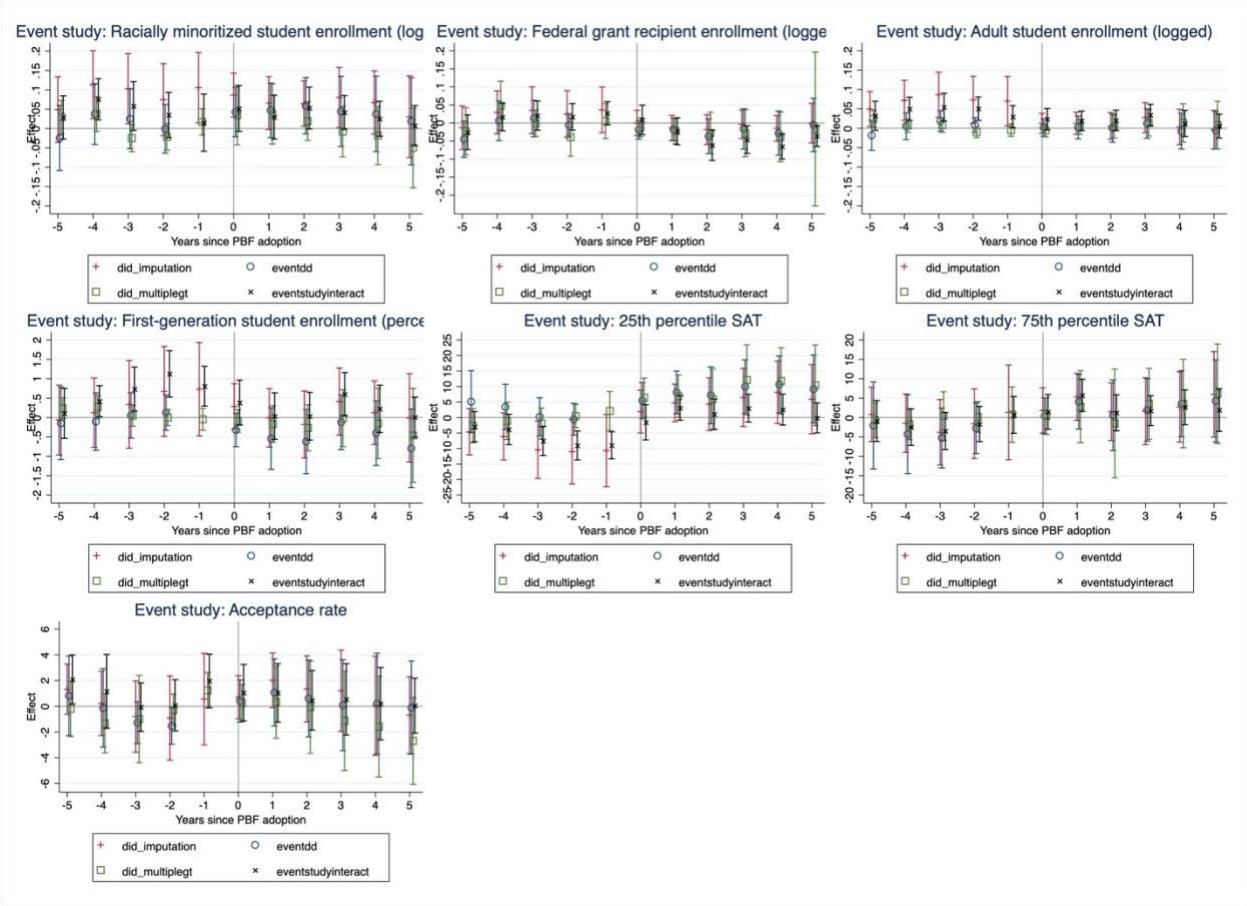
Source: Authors' review of state policy documents.

Figure 3. Number of PBF policies for four-year universities by key policy features, 1999-2019



Source: Authors' review of state policy documents.

Figure 4. Event study results



Online Supplementary Materials

Table A1: Effects of binary measure of PBF on college enrollment and selectivity outcomes

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)		First-generation student enrollment (%)		25th percentile SAT scores		75th percentile SAT scores		Acceptance rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Panel A: All four-year colleges													
Binary PBF indicator	0.018	0.037	-0.033	-0.024	0.023	0.017	0.028	-0.089	5.801	4.296	5.980**	5.256	-1.552	-1.641
	(0.035)	(0.030)	(0.031)	(0.016)	(0.024)	(0.016)	(0.476)	(0.354)	(2.471)	(2.589)	(2.012)	(2.162)	(1.073)	(1.078)
Number of observations	12,315	11,744	10,684	10,166	12,523	11,744	10,874	10,163	9,112	8,631	9,112	8,631	9,422	8,926
	Panel B: Highly selective colleges													
Binary PBF indicator	-0.088	-0.088	-0.079	-0.101**	-0.088	-0.041	-0.925	-0.177	1.674	2.613	2.306	5.094	-2.241	-2.117
	(0.046)	(0.031)	(0.029)	(0.029)	(0.035)	(0.025)	(0.778)	(0.540)	(9.016)	(5.863)	(8.022)	(4.281)	(2.256)	(1.684)
Number of observations	869	841	756	731	869	841	751	730	721	699	721	699	721	699
	Panel C: Moderately selective colleges													
Binary PBF indicator	0.015	0.024	-0.022	-0.031	0.023	0.010	0.194	0.050	7.371	6.337	6.378	6.094	-2.085	-2.101
	(0.036)	(0.028)	(0.037)	(0.021)	(0.026)	(0.017)	(0.525)	(0.392)	(2.959)	(2.576)	(2.500)	(2.381)	(1.241)	(1.105)
Number of observations	8,094	7,933	7,027	6,884	8,096	7,929	7,038	6,886	6,277	6,162	6,277	6,162	6,395	6,279
	Panel D: Less selective and open access colleges													
Binary PBF indicator	0.020	0.043	-0.098	-0.031	0.050	0.027	-0.436	-0.559	-0.193	-6.507	3.559	-1.154	1.717	1.840
	(0.045)	(0.045)	(0.037)	(0.030)	(0.037)	(0.021)	(0.548)	(0.309)	(5.806)	(5.534)	(4.367)	(4.804)	(1.575)	(1.898)
Number of observations	2,276	2,242	1,976	1,944	2,276	2,242	1,974	1,943	1,473	1,457	1,473	1,457	1,548	1,531
	Panel E: Minority-serving institutions													
Binary PBF indicator	-0.059	-0.080	-0.063	-0.062	0.051	0.031	0.401	0.052	0.560	0.692	-0.954	1.599	-2.036	-2.980
	(0.051)	(0.032)	(0.042)	(0.029)	(0.027)	(0.015)	(0.565)	(0.515)	(4.274)	(4.636)	(2.951)	(5.984)	(2.621)	(3.196)
Number of observations	2,495	2,437	2,175	2,128	2,515	2,435	2,173	2,093	1,775	1,736	1,775	1,736	1,839	1,794
	Panel F: Non-minority-serving institutions													
Binary PBF indicator	0.008	0.028	-0.033	-0.019	0.019	0.017	0.064	-0.007	7.688*	6.221	7.269**	6.594**	-1.513	-1.489
	(0.034)	(0.030)	(0.029)	(0.018)	(0.022)	(0.017)	(0.429)	(0.327)	(2.802)	(2.591)	(2.363)	(2.239)	(1.170)	(1.110)
Number of observations	8,878	8,698	7,703	7,542	9,031	8,700	7,864	7,549	6,740	6,613	6,740	6,613	6,942	6,812
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Covariates		X		X		X		X		X		X		X

Notes: Referent category is no PBF. Binary PBF indicator is 1 for institutions subject to PBF in a given year and 0 otherwise. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Table A2: Effects of continuous measure of PBF on college enrollment and selectivity outcomes

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)		First-generation student enrollment (%)		25th percentile SAT scores		75th percentile SAT scores		Acceptance rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Panel A: All four-year colleges													
Percent of funds at stake under PBF	-0.002	0.000	-0.001	0.000	0.001	0.001	-0.012	0.002	0.283**	0.259**	0.205	0.179	0.012	0.009
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.010)	(0.005)	(0.081)	(0.077)	(0.100)	(0.092)	(0.024)	(0.024)
Number of observations	12,315	11,744	10,684	10,166	12,523	11,744	10,874	10,163	9,112	8,631	9,112	8,631	9,422	8,926
	Panel B: Highly selective colleges													
Percent of funds at stake under PBF	-0.002	0.000	-0.000	0.001	0.000	0.001	-0.040	-0.002	0.485*	0.534***	0.126	0.208	-0.014	-0.033
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.015)	(0.008)	(0.167)	(0.135)	(0.145)	(0.105)	(0.032)	(0.027)
Number of observations	869	841	756	731	869	841	751	730	721	699	721	699	721	699
	Panel C: Moderately selective colleges													
Percent of funds at stake under PBF	-0.003*	-0.002	-0.001	-0.000	0.001	0.000	-0.011	0.003	0.313***	0.278***	0.210	0.180	0.011	0.014
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.009)	(0.006)	(0.073)	(0.070)	(0.117)	(0.103)	(0.022)	(0.019)
Number of observations	8,094	7,933	7,027	6,884	8,096	7,929	7,038	6,886	6,277	6,162	6,277	6,162	6,395	6,279
	Panel D: Less selective and open access colleges													
Percent of funds at stake under PBF	0.003	0.003	-0.003	0.000	0.003	0.001	-0.006	-0.005	-0.017	-0.004	0.186	0.131	0.042	0.025
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.021)	(0.013)	(0.124)	(0.174)	(0.115)	(0.164)	(0.075)	(0.068)
Number of observations	2,276	2,242	1,976	1,944	2,276	2,242	1,974	1,943	1,473	1,457	1,473	1,457	1,548	1,531
	Panel E: Minority-serving institutions													
Percent of funds at stake under PBF	-0.001	0.003	-0.001	0.003	-0.001	0.001	-0.006	0.023	-0.114	-0.106	0.056	0.055	0.072	0.015
	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.023)	(0.019)	(0.215)	(0.233)	(0.176)	(0.243)	(0.063)	(0.063)
Number of observations	2,495	2,437	2,175	2,128	2,515	2,435	2,173	2,093	1,775	1,736	1,775	1,736	1,839	1,794
	Panel F: Non-minority-serving institutions													
Percent of funds at stake under PBF	-0.003	-0.002	-0.002	-0.000	0.001	0.001	-0.007	0.001	0.352***	0.328***	0.225	0.201	0.004	0.007
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.008)	(0.006)	(0.086)	(0.076)	(0.102)	(0.084)	(0.025)	(0.024)

Number of observations	8,878	8,698	7,703	7,542	9,031	8,700	7,864	7,549	6,740	6,613	6,740	6,613	6,942	6,812
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Covariates		X		X		X		X		X		X		X

Notes: Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Table A3: Effects of PBF dosage on college enrollment and selectivity outcomes by Carnegie classification and instructional expenditures per student

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)		First-generation student enrollment (%)		25th percentile SAT scores		75th percentile SAT scores		Acceptance rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A: Research universities														
Low-dosage PBF	-0.005	-0.003	-0.015	-0.022	-0.022	-0.008	0.137	-0.186	2.634	1.283	2.649	1.938	-1.250	-0.563
	(0.045)	(0.034)	(0.022)	(0.021)	(0.027)	(0.023)	(0.469)	(0.359)	(2.773)	(2.342)	(1.926)	(1.744)	(0.756)	(0.819)
High-dosage PBF	-0.123	-0.055	-0.027	0.011	-0.010	0.014	-0.710	0.009	13.647	11.648	8.364	6.538	-0.756	-0.366
	(0.091)	(0.057)	(0.045)	(0.035)	(0.055)	(0.044)	(1.002)	(0.546)	(5.873)	(5.158)	(5.291)	(4.559)	(1.819)	(1.624)
Number of observations	4,775	4,683	4,146	4,067	4,784	4,682	4,152	4,059	3,752	3,701	3,752	3,701	3,816	3,759
Panel B: Master's universities														
Low-dosage PBF	0.051	0.067	-0.025	-0.035	0.039	0.036	-0.022	0.047	5.052	3.188	4.199	3.764	-2.554	-3.135
	(0.039)	(0.038)	(0.046)	(0.021)	(0.025)	(0.017)	(0.610)	(0.448)	(3.603)	(3.421)	(3.050)	(2.921)	(1.797)	(1.698)
High-dosage PBF	-0.120	-0.011	-0.164	-0.110	-0.024	-0.038	-0.855	-0.740	13.898	9.155	13.957	10.673	-2.520	-2.407
	(0.108)	(0.074)	(0.090)	(0.055)	(0.058)	(0.039)	(1.318)	(0.832)	(7.321)	(7.747)	(6.803)	(7.524)	(3.219)	(3.013)
Number of observations	5,566	5,437	4,829	4,714	5,708	5,438	4,975	4,715	4,073	3,982	4,073	3,982	4,229	4,133
Panel C: Baccalaureate colleges														
Low-dosage PBF	0.074	0.026	-0.087	0.032	0.067	0.041	-0.166	-0.138	0.176	3.507	8.174	10.610	0.569	-0.549
	(0.067)	(0.069)	(0.083)	(0.039)	(0.042)	(0.031)	(0.700)	(0.648)	(4.695)	(3.806)	(6.100)	(5.547)	(2.463)	(2.055)
High-dosage PBF	0.184	0.155	0.055	0.079	0.276*	0.125	2.170	2.596	1.402	21.497	8.994	20.634*	4.205	2.570
	(0.110)	(0.115)	(0.186)	(0.087)	(0.101)	(0.076)	(0.955)	(1.145)	(16.184)	(11.772)	(11.579)	(7.414)	(3.020)	(3.572)
Number of observations	1,974	1,624	1,709	1,385	2,031	1,624	1,747	1,389	1,287	948	1,287	948	1,377	1,034
Panel D: Highly resourced colleges														
Low-dosage PBF	0.005	0.004	-0.004	-0.018	-0.048	-0.029	-0.166	-0.249	3.926	3.885	3.124	2.720	-1.637	-1.943
	(0.061)	(0.049)	(0.029)	(0.029)	(0.035)	(0.021)	(0.567)	(0.403)	(4.168)	(3.223)	(3.707)	(3.059)	(1.048)	(0.964)
High-dosage PBF	-0.042	-0.003	0.014	0.022	0.009	0.019	-1.152	-0.514	5.324	8.170	0.890	2.795	0.209	-0.045
	(0.139)	(0.085)	(0.067)	(0.049)	(0.078)	(0.043)	(0.919)	(0.568)	(9.004)	(6.200)	(8.518)	(5.851)	(1.948)	(1.866)
Number of observations	2,904	2,844	2,507	2,453	2,941	2,845	2,528	2,443	2,236	2,196	2,236	2,196	2,309	2,267

	Panel E: Less resourced colleges													
Low-dosage PBF	0.056	0.041	-0.010	0.002	0.071	0.046	0.309	0.253	2.525	3.050	2.286	2.604	-0.842	-1.944
	(0.046)	(0.033)	(0.035)	(0.024)	(0.032)	(0.027)	(0.534)	(0.449)	(3.564)	(3.421)	(3.133)	(3.262)	(1.537)	(1.496)
High-dosage PBF	0.056	0.092	0.028	0.027	0.014	0.014	0.767	1.064	3.690	3.834	8.384	6.274	1.118	-0.188
	(0.203)	(0.144)	(0.095)	(0.058)	(0.085)	(0.038)	(1.030)	(0.696)	(6.839)	(8.142)	(6.239)	(7.936)	(2.385)	(2.538)
Number of observations	2,932	2,902	2,522	2,494	2,988	2,902	2,578	2,501	1,920	1,911	1,920	1,911	2,000	1,990
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Covariates		X		X		X		X		X		X		X

Notes: High and low resource colleges are in the top and bottom, respectively, quartile for per-FTE instructional expenditures. Referent category is no PBF. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Table A4: Effects of PBF equity metrics on college enrollment among the subpopulations they target by Carnegie classification and instructional expenditures per student

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Research universities					
PBF without specific student metric	0.005	0.005	-0.031	-0.035	-0.013	-0.001
	(0.055)	(0.037)	(0.029)	(0.027)	(0.030)	(0.025)
PBF with specific student metric	-0.084	-0.045	-0.003	-0.002	-0.060	-0.022
	(0.073)	(0.052)	(0.029)	(0.030)	(0.040)	(0.033)
Number of observations	4,775	4,683	4,146	4,067	4,784	4,682
	Panel B: Master's universities					
PBF without specific student metric	0.012	0.039	0.013	-0.026	0.036	0.030
	(0.053)	(0.042)	(0.064)	(0.021)	(0.026)	(0.018)
PBF with specific student metric	0.066	0.094	-0.099	-0.062	-0.005	0.007
	(0.047)	(0.046)	(0.047)	(0.028)	(0.064)	(0.041)
Number of observations	5,566	5,437	4,829	4,714	5,708	5,438
	Panel C: Baccalaureate colleges					
PBF without specific student metric	0.082	0.058	-0.086	0.049	0.099	0.061
	(0.071)	(0.069)	(0.111)	(0.048)	(0.053)	(0.030)
PBF with specific student metric	0.133	0.025	-0.003	0.022	0.156	0.038
	(0.084)	(0.100)	(0.137)	(0.049)	(0.104)	(0.062)
Number of observations	1,974	1,624	1,709	1,385	2,031	1,624
	Panel D: Highly resourced colleges					
PBF without specific student metric	0.005	0.010	-0.016	-0.022	-0.042	-0.025
	(0.074)	(0.053)	(0.030)	(0.031)	(0.040)	(0.023)
PBF with specific student metric	-0.011	-0.007	0.010	-0.005	-0.029	-0.011
	(0.087)	(0.073)	(0.045)	(0.045)	(0.041)	(0.026)
Number of observations	2,904	2,844	2,507	2,453	2,941	2,845

	Panel E: Less resourced colleges					
PBF without specific student metric	0.019	0.024	-0.022	0.023	0.080	0.057
	(0.061)	(0.034)	-0.038	-0.021	(0.033)	(0.026)
PBF with specific student metric	0.175	0.127	0.017	-0.012	-0.015	-0.023
	(0.077)	(0.073)	-0.049	-0.028	(0.075)	(0.034)
Number of observations	2,932	2,902	2,522	2,494	2,988	2,902
Two-way fixed effects	X	X	X	X	X	X
Covariates		X		X		X

Notes: High and low resource colleges are in the top and bottom, respectively, quartile for per-FTE instructional expenditures. Referent category is no PBF. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Table A5: Effects of binary measure of PBF on enrollment and selectivity outcomes (alternate samples)

	Racially minoritized student enrollment (ln)		Federal grant recipient enrollment (ln)		Adult student enrollment (ln)		First-generation student enrollment (%)		25th percentile SAT scores		75th percentile SAT scores		Acceptance rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Panel A: Excluding colleges subject to PBF at the beginning of the analytic time period														
Binary PBF indicator	0.026	0.056	0.026	0.016	-0.025	-0.062	-0.031	-0.005	5.331	4.547	6.371	5.149	-1.526	-1.762
	(0.041)	(0.033)	(0.029)	(0.018)	(0.573)	(0.386)	(0.035)	(0.019)	(2.887)	(2.941)	(2.494)	(2.659)	(1.223)	(1.174)
Number of observations	10,814	10,814	10,814	10,814	9,367	9,367	8,854	8,854	7,006	7,006	7,006	7,006	7,288	7,288
Panel B: Excluding colleges subject to PBF at the beginning of the analytic time period and colleges where PBF was abandoned prior to 2019														
Binary PBF indicator	0.065	0.097	0.051	0.025	0.162	-0.042	-0.019	0.001	2.326	1.974	3.861	2.751	-1.067	-0.719
	(0.057)	(0.044)	(0.043)	(0.028)	(0.949)	(0.625)	(0.050)	(0.029)	(3.157)	(3.211)	(2.843)	(2.832)	(1.602)	(1.377)
Number of observations	8,224	8,224	8,226	8,226	7,133	7,133	6,811	6,811	5,397	5,397	5,397	5,397	5,610	5,610
Two-way fixed effects	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Covariates		X		X		X		X		X		X		X

Notes: Referent category is no PBF. Analyses in both panels exclude colleges subject to PBF in 1997 for racially minoritized, adult, and first-generation student enrollment, colleges subject to PBF in 1999 for federal grant recipient enrollment, and colleges subject to PBF in 2001 for SAT and acceptance rate outcomes. Analyses in Panel B also exclude colleges where PBF was abandoned prior to 2019. Covariates include FTE undergraduate enrollment (logged), percent of students with race unknown, percent part-time undergraduate enrollment, in-state tuition (logged), per-FTE instructional expenditures (logged), per-FTE state appropriations (logged), per capita income (logged), unemployment rate, percent of adults with a bachelor's degree, college-aged population (logged), share of Black college-aged adults, share of Latinx college-aged adults, and share of American Indian or Alaska Native college aged adults. Robust standard errors clustered at the state level. * signifies p<.01. ** signifies p<.005, and *** signifies p<.001.

Figure A1. Event study results, excluding colleges subject to PBF at the start of the analytic time period

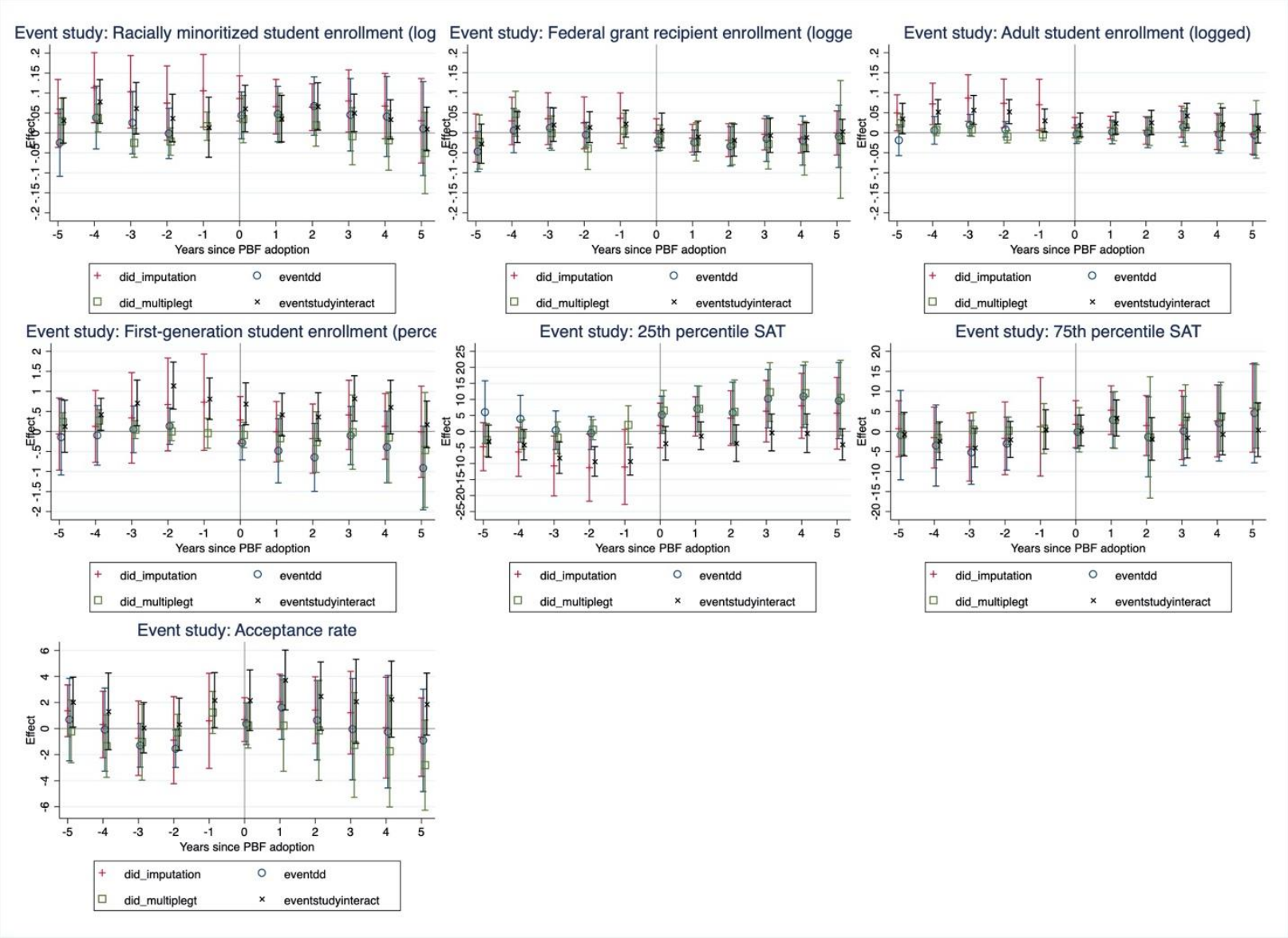


Figure A2. Event study results, excluding colleges subject to PBF at the start of the analytic time period and colleges where PBF was abandoned prior to 2019